

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE <b>1998</b>		2. REPORT TYPE		3. DATES COVERED <b>00-00-1998 to 00-00-1998</b>	
4. TITLE AND SUBTITLE <b>Autonomous Underwater Vehicle Upgrade for Smart Sensor Imaging System</b>				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>University of California, San Diego, Scripps Institution of Oceanography, La Jolla, CA, 92093</b>				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release; distribution unlimited</b>					
13. SUPPLEMENTARY NOTES <b>See also ADM002252.</b>					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT <b>Same as Report (SAR)</b>	18. NUMBER OF PAGES <b>2</b>	19a. NAME OF RESPONSIBLE PERSON
a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>			

# **Autonomous Underwater Vehicle Upgrade for Smart Sensor Imaging System**

Jules S. Jaffe

Scripps Institution of Oceanography, La Jolla, CA.

phone: (619) 534-6101, fax:(619) 534-7641 e-mail: [jules@mpl.ucsd.edu](mailto:jules@mpl.ucsd.edu)

Award #:N00014-97-1-0110

## **LONG TERM OBJECTIVE**

The long term goal of this program is to develop a next generation of underwater optical imaging systems that utilize new sensors and advanced signal processing in order to acquire more information about the ocean environment.

## **SCIENTIFIC/TECHNICAL OBJECTIVES**

The specific goal of this project is to demonstrate the utility of a fast read out 1 dimensional CCD camera in concert with a scanning laser system. Theoretically, the system should permit the observation of microscale bathymetry (1 mm - 10 cm) at ranges of 2 m to 10 m with concurrent observation of bottom albedo at extended imaging ranges (3-7 total attenuation lengths). The system is called L-Bath for laser bathymetry. This funding increment provided additional support for the system development so that the system could be mounted and operated from an AUV.

## **APPROACH**

This program was basically an upgrade to our existing funding to augment our resources so that we could deploy the L-Bath laser bathymetry system on an AUV. The original program consisted of having the system towed from a surface ship.

## **TASKS COMPLETED**

In order to mount the system on an AUV we redesigned the entire housing and constructed a new one that enclosed the laser and it's power supply. This almost doubled the size of the system, however, was necessary so that the system could be used in an autonomous mode. In addition, in order to accommodate the increased power requirements we purchased and mounted a set of battery packs on the vehicle. Finally, the whole system was reballasted and trimmed so that it would be ready to go on the AUV.

The entire AUV upgrade was accomplished during the two years of this funding increment. Software modifications were also necessary so that the system could function in an autonomous mode, that is, to collect data without real time supervision.

## **RESULTS**

A great deal of the system tests and results were described in a companion report for project N00014-96-1-0008, Smart Sensor for Extended Range Optical Imaging. They will not be entirely reiterated here. Starting in 1997, the system tests that are described were accomplished with the new configuration of the laser in the autonomous mode. This included tank tests in the large (10m tank) which

were accomplished at a range of 3.6 meters. System results from this test demonstrate that the system optics were actually much improved as the system did not need to rely on a fiber optic conduit. This resulted in a much smaller divergence angle for the laser. In addition, the at-sea tests, accomplished in July of 1998 were performed with the system in the autonomous mode. Although the system was still tethered to the ship, the results support the sea-worthiness of the AUV modification.

## **IMPACT**

We believe that the evolution of this instrument will have important ramifications for looking at objects which are lying on the sea floor which have some surface expression. Hopefully, the important advantage of our device will be the ability to distinguish, at extended ranges, between man made and natural objects.

## **TRANSITIONS**

Several other programs within the NAVY have expressed interest in our device. Based on our at-sea data using a calibrated test target, an new ONR DRI in high frequency backscatter has decided to fund our participation. We will be measuring bottom microbathymetry at the same time that the acoustics experimentalists are measuring bottom backscatter. In addition, other parts of the NAVY have expressed interest in testing our system for various purposes in order to obtain quantitative bottom images of articles on the sea floor.

## **RELATIONSHIPS TO OTHER PROJECTS**

As stated above, the device is going to be used to measure bottom microbathymetry in a new ONR DRI which will measure bottom backscatter. We have also been pursuing the possibility of using the system to help marine archaeologists to obtain quantitative 3-dimensional bottom images of shipwrecks. Since L-Bath measures a line through the radiance pattern created by the underwater laser, this provides many interesting opportunities for performing pelagic studies with the system to study particulate matter in the water column, fluorescence of small particles as well as measurement of the volume scattering function at the angles that the system is interrogating. In conclusion, we expect this tool to become a part of many studies that we are in the process of envisioning and proposing.

## **REFERENCES**

K.D. Moore, J.S. Jaffe and B. L. Ochoa. Development of a new underwater bathymetric laser imaging system: L-Bath. J. Atmos. and Oceanic Tech., 40 ms. pgs. (1998). (SUBMITTED - August, 1998)

Web site: <http://pandora.ucsd.edu>